Incorporating Time-of-Flight Analysis in MRI Scanners in Order to Capture All Necessary Data in Single Pulse

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Introduction

Conventional MRI technology works by measuring RF feedback after a magnetic pulse from each of a series of thin, two-dimensional slices. The quality of images and the length of time required to perform the test are hampered by the use of such a process. If data from all points in the person or object being scanned could be collected and properly interpreted from a single pulse, the quality and availability of the medical scan would be increased and the cost would be reduced.

Abstract

Although existing technology measures feedback from a single slice of tissue at a time, each MRI pulse exposes the whole of body to the powerful magnetic field associated with an MRI machine. Data is therefore being generated from the entirety of the (usually, human body) being imaged. The vast majority of this data is ignored and discarded with each pulse.

In order to overcome this inefficiency, a novel RF detector mechanism could be used in order to capture feedback exclusively from one, specific direction of momentum and time-of-flight analysis could be then be used to estimate the exact spatial source of an emission relative to the timing of the magnetic pulse. While a modest increase in data throughput capacity would be required, this increase would be well-within the range of capability of modern computers.

More challenging would be the RF detection mechanism, which would comprise the entire inner wall of such an MRI machine and would necessarily incorporate mechanisms for blocking RF approaching from offset angles. This is necessary as detecting RF from multiple angles would create uncertainty as to the three-dimensional position of the source.

By observing RF emissions as they strike all parts of the inner wall and by observing only those emissions with head-on angular momentum (made possible through the use of a momentum-sensitive blocking metamaterial layer) and subsequently binning received data according to time of arrival as measured by a compact atomic clock, such a mode of function would be entirely possible.

Conclusion

The technology which makes such an approach possible only came into being within the past few years, however, the technology is sufficiently inexpensive

that no increase to the per-unit cost of MRI machines could be expected to be incurred as a consequence of this redesign. End-user costs could be expected to be dramatically reduced given that time-in-machine and electricity utilized would both be dramatically reduced.